

Retroflo

REVOLUTIONARY PUMP CONTROL

CASE STUDY: RETROFLO RPC_2000

CLIENT:	SCOTTISH WATER
STATION NAME AND LOCATION:	CHARLOTTE STREET SEWAGE PUMPING STATION
NO. OF PUMPS AND INSTALLATION TYPE:	TWO OFF – SUBMERGED IN WET-WELL
OPERATING ARRANGEMENT:	DUTY/STANDBY
DATE OF INSTALLATION:	JUNE 2009



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SUMMARY

Charlotte Street Sewage Pumping Station (SPS) in Kirkcaldy is operated by Scottish Water and serves an urban population of nearly 50,000. Situated as the last pumping station before the treatment works in Kirkcaldy's sewerage network, the station handles large flows and was subject to frequent blockages.

The Retroflo RPC_2000 Pump Control System was successfully installed and commissioned at Charlotte Street SPS in the first week of June 2009. In its first three months of operation the RPC_2000 performed 47 successful Pre-Blockage Detection and Self-Cleanse routines, all of which returned the pumps to optimum performance. During this period there were no recorded blockages and therefore no need for reactive maintenance call-outs.

Based on analysis by Scottish Water, minimum annual savings of £30,000 will be achieved as a result of the Charlotte Street RPC_2000 application, which equates to a payback well inside the first year.

Charlotte Street Sewage Pumping Station was classified as a Scottish Water reputational site due to flooding issues in a public area. Frequent blockages were caused by solids settlement in the sewer and the sheer volume of rag passing through the network. This led to the filling of the storm attenuation tank, which eventually flooded the area with raw sewage and led to complaints from local residents and businesses. Removing pump blockages at the SPS requires a crane to lift the pumps from the wet well located below a public car park. As a result, operational expenditure for the station was extremely high and new pumps had to be installed three times in four years.

During installation the wet well was thoroughly cleaned to determine the operating criteria of the pumps. This data was then used as the base line for monitoring all control conditions associated with the station. The condition of the SPS wet well was inspected by a Scottish Water team two months after the installation and it was found to be in a clean condition with no scum lines, grease or ragging visible.



Pump lift and clean

SCOPE OF WORK

Charlotte Street Sewage Pumping Station Data

PUMP TYPE	ITT Flygt 3312.745 140kW
IMPELLOR TYPE	ITT Flygt N-Type
NUMBER OF PUMPS	2
VARIABLE SPEED DRIVES	Yes
FLOW-METER	Yes
PASS FORWARD FLOW	365 l/s

Retroflo's Scope of Work was to interface the RPC_2000 with the station's existing PLC, while maintaining the functionality of the station during installation, ensuring pass forward flow to Kirkcaldy waste water treatment works. Charlotte Street's two existing pumps were fitted with Variable Speed Drives (VSDs). These VSDs required the addition of analogue output cards to enable signals to be transmitted to the RPC_2000.

The RPC_2000 is set up to accommodate an interface with the upstream treatment works. This enables the system to reduce onward flow to 80% or stop flow entirely when the treatment works is unable to handle the gravity-fed inlet flow during inclement weather conditions. Charlotte Street SPS is the main pumping station immediately downstream of the sewage works and receives inlet flow from various other sewage pumping stations throughout the Kirkcaldy area.

The RPC_2000 was installed within the telemetry section of the station MCC panel. Telemetry signals were hard wired from the PLC and RPC_2000 to the RTU for onward transmission to the Scottish Water Open Enterprise telemetry monitoring network.



Typical Pump Blockage

SYSTEM FUNCTIONALITY



The key features provided by the RPC_2000 are:

- Operator Selected Batch or Constant Level Pumping
- Operator Selected Cycling Pump Duty or Fixed Pump Duty
- Pre-Blockage Detection
- Pump Self-Cleansing Routine
- Intelligent Flushing Cycle
- Periodic Efficiency Testing
- Consented Flow Security
- Real Time and Historical Data Review and Storage.

Interface with the RPC_2000 is via a dedicated, easy-view, full language and menu-driven touch-screen. Navigation and interrogation of parameters, settings, operating data and logs is straightforward with password protection ensuring that adjustments and changes are carried out only by authorised personnel.

Once logged in, the operator can easily select and change the feature options using the full English language entries on the screen. System settings, real-time and historic data, including trends data, can be viewed using a few simple touch-screen commands on the RPC_2000 display.

ENVIRONMENTAL EFFICIENCIES

Environmental responsibility, coupled with rising energy costs, has increased the impetus to reduce operational expenditure and improve carbon management. The RPC_2000 determines the most efficient speed setting, minimising the power used to move the required volume of liquid. In this way the use of VSDs aligned with Retroflo's optimised control system means real energy savings can be realised in many cases for the first time. Operational savings are also derived from fewer call-outs and a lower incidence of operator interventions for clearing blockages. A reduction in pump speed also reduces operating temperatures, thus reducing wear on pump components such as bearing and seals, increasing maintenance intervals and prolonging asset life.

A FLEXIBLE SOLUTION

The RPC_2000 is applicable to a wide range of manufacturers' equipment (pumps and drives) and may be installed in new control panels, or integrated into existing systems. The retro-fit capability provides opportunities for dealing with historically problematic sites and the system's ease of implementation and touch-screen operation is a key benefit to pumping station operators. Access to the operating parameters is provided for commissioning and optimisation and Trend mimics enable comprehensive interrogation of the system. A help menu is available at each screen to provide further guidance.

RPC_2000 FEATURES

OPERATOR SELECTED BATCH OR CONSTANT LEVEL PUMPING

The currently selected mode for Charlotte Street SPS is constant level Pumping, as this was determined the most suitable for the SPS design. As the liquid level in the well rises to pre-determined level the duty pump will be operate. Each time a pump is called to run a short maximum boost cycle is initiated, ensuring any debris that may have settled in a pump or its pipe-work is flushed clear. This flushing feature is also repeated at each pump stop. At high inflows the duty pump operates at maximum speed.

OPERATOR SELECTED CYCLING PUMP DUTY OR FIXED PUMP DUTY

The operator can choose between an automatic selection of the duty and assist pumps or fix the duty arrangement when, for instance, there is a pump maintenance requirement. Under normal conditions Cycling Pump Duty is selected and the operation will rotate around 2 off pumps based on a run-timer, currently set for 60 minutes. In this particular installation it is important to avoid long periods of continuous, individual pump operation, as it can increase the potential for blockage to occur. Configuring the feature for *Charlotte Street SPS* and adjusting the parameters was all accomplished via the display screen.

PRE-BLOCKAGE DETECTION

A key feature of the RPC_2000 is its uniquely patented Pre-Blockage Detection facility. Designed to combat the traditional blockage problems associated with pumping sewage, the system pre-empts a blockage situation by comparing real-time data against data benchmarked to actual performance of the pump in the well rather than to the flow curves. The system continuously monitors motor power, current, torque and speed, together with wet well level and volumetric flow, and compares this with up to 10,000 pre-determined reference points per pump to identify and correct operational and efficiency issues.

PUMP SELF-CLEANSING ROUTINE

As described above, on detection of debris build-up on the pump impellor the RPC_2000 initiates a pump rapid reversal cycle. If the pump operates inefficiently, indicating a solids build-up on the pump impeller, a self-cleansing routine is initiated. The pump is stopped and reversed within site defined parameters, a process repeated until operating efficiency is re-established. This ensures that the impeller remains debris free, maintaining optimum pump performance and eliminating the need for costly reactive maintenance call outs.

INTELLIGENT FLUSHING CYCLE

The RPC_2000's Intelligent Flushing Cycle can be selected to operate based on time or well liquid level. With the level-based daily cycle selected at Charlotte Street SPS, the same volume of water is flushed at approximately the same time every day. Full safeguards are in place to ensure the flushing cycle only operates during clearly defined inflow conditions. The liquid level is permitted to rise without the pumps operating until the flushing cycle level is attained. The rapid emptying of the well ensures adequate dilution of settled solids enabling the solids to be passed forward. It also allows rising main self-cleansing velocities to be achieved, at regular intervals, to prevent deposition in the main and fat build-up in the well. Once the Flushing Cycle conditions have been met then two pumps will be operated, as described earlier, to pass forward the consented flow rate.

PERIODIC EFFICIENCY TESTING

The feature has provided both Operations and Maintenance teams with the ability to monitor pump wear and also compare performance between pumps. Each pump is automatically checked, on a regular basis, to compare its flow rate and corresponding power consumption against values measured during commissioning of the RPC_2000. Significant deviations will be flagged up allowing Scottish Water to take pre-emptive action.

CONSENTED FLOW SECURITY

Again the feature is selectable by the operator and provides both monitoring and alarm functions for the consented flow condition. During high level [storm] conditions the Pre-Blockage Detection is disabled to ensure uninterrupted pump operation. However, should measured flow fall below the consent value, then pump duty is rotated and the combination of Duty/Standby from the two pumps available is changed. If consented flow is then achieved the new pump duty will remain but should flow fail to reach consented flow then the RPC_2000 will continue to try all permutations of pump operation. If Consented Flow is not achieved then the Consent Alarm is triggered. Accurate flow control is a requirement, as exceeding consented flow can create problems at the Kirkcaldy Waste Water Treatment Works, including spillage.

REAL TIME AND HISTORICAL DATA REVIEW AND STORAGE

A unique feature of the RPC_2000 is its continuous monitoring of pump performance against the site-specific benchmark measurements stored over the full range of wet well levels and pump speeds. The system stores up to 40,000 pump and well characteristics in its memory, enabling immediate action when pump clogging occurs. The default screen displays current pump duty arrangement, availability and operating status together with wet-well level and pumped flow rate. From here navigation around the parameters and stored data is straightforward.

FEATURE DERIVED SYSTEM BENEFITS AND IMPROVEMENTS

With the RPC_2000 in control of the Duty/Standby pumps at Charlotte Street SPS the main objective of reduced blockages was met via the pre-blockage detection, the pump self cleanse routine and the intelligent flushing cycle.

It was noted that following a few months of operation that the storm pumps had not been required, a situation that had previously been “unimaginable”. Storm pumps divert sewage via the long sea outfall pipe into the Firth of Forth under heavy weather conditions. That the storm pumps had not been used, despite torrential rain conditions throughout the month of July when other parts of Kirkcaldy were flooded, is testament to the effectiveness of the RPC_2000.

The on-site training carried out by Retroflo Engineers for Scottish Water operational and maintenance staff was comprehensive. Delivered in a clear and easily understand format, operational staff were soon conversant with the range of functionality and interrogation tools provided by the RPC_2000.

In the seven months following installation and commissioning the RPC_2000 has delivered operational and maintenance efficiencies and improved the overall energy performance of Charlotte Street SPS. The wet well has been inspected frequently and to date is as clean as the day it was vactored and jet washed during commissioning.

The pre-blockage detection and self-cleanse routine has operated successfully over 100 times throughout this period, keeping the pumps clean and running efficiently.

Although the lack of pre-installation baseline data makes it impossible to determine the exact energy savings derived from the installation of the RPC_2000, it is safe to say that the efficient operation of pumps equates to a considerable saving in energy usage. There is also clear evidence that the system has reduced operation maintenance costs significantly. Since installation the pumps at Charlotte Street SPS have not been lifted from the wet well due to blockages.

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